Watershed Characterization Document
Cuffytown Creek (Hydrologic Unit Code: 03060107-010-050, -060, -070 & Station SV-351)
Fecal Coliform Bacteria

June 2005

SCDHEC Technical Report Number: 018-05

United States Environmental Protection Agency

Region 4 serving the southeast

In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et.seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S Environmental Protection Agency is hereby establishing a Total Maximum Daily Load (TMDL) for Fecal Coliform for Cuffytown Creek in the Savannah River Basin. Subsequent actions must be consistent with this TMDL.

James D. Giattina, Director Water Management Division	Date

Abstract

A Total Maximum Daily Load (TMDL) has been developed for Cuffytown Creek, which is a tributary of the Stevens Creek in Greenwood, McCormick, and Edgefield Counties, SC. This creek has been on South Carolina's 303(d) list since 1998. Cuffytown Creek is impaired at water quality monitoring station SV-351 (at S-33-138). During the assessment period for the 2004 303(d) list (1998-2002), 21 % of samples exceeded the water quality standard. The watershed of Cuffytown Creek is mostly forest, pasture, and cropland with little developed land. There are no point sources or designated Municipal Separate Storm Sewer Systems (MS4) in the watershed. The probable sources of fecal coliform bacteria in Cuffytown Creek are runoff from agricultural land, cattle-in-streams, and failing septic systems.

The load-duration curve methodology was used to calculate the existing load and the TMDL load for the creek. The existing load and TMDL load are presented in Table Ab-1. In order to reach the target load for Cuffytown Creek, reductions in the existing load to the creek of 11 % will be necessary. Resources and several TMDL implementation strategies to bring about this reduction are suggested.

Table Ab-1. Total Maximum Daily Load for Cuffytown Creek at SV-351.

Station ID	Existing Waste Load	TMDL WLA		Existing Load	TMDL LA	MOS	TMDL	Percent Reduction[3]
	Continuous (cfu/day)	Continuous[1] (cfu/day)	MS4[2]	(cfu/day)	(cfu/day)	(cfu/day)	(cfu/day)	
SV-351	0	NA	NA	5.6E+11	4.98E+11	2.62E+10	5.24E+11	11 %

Table Notes:
1. WLA is expressed as total monthly average.
2. MS4 expressed as percent reduction equal to LA reduction.
3. Percent reduction applies to LA and MS4 components when an MS4 is in the watershed.

.

Table of Contents

Tables

Figures

1.0 INTRODUCTION

1.1 Background

Fecal coliform bacteria is widely used as an indicator of pathogens in surface waters and wastewater. Acute gastrointestinal illnesses affect millions of people in the United States and cause billions of dollars of costs each year (Gaffield et al., 2003). Of these illnesses many are caused by contaminated drinking water. Untreated stormwater runoff has been associated with a number of disease outbreaks, most notably the outbreak in Milwaukee that caused many deaths.

Though occurring at low levels from natural sources, the concentration of fecal coliform bacteria can be elevated in water bodies as the result of pollution. Sources of fecal coliform bacteria can be diffuse or nonpoint sources, such as runoff, failing septic systems, and leaking sewers. The source of the pollutant can also be a point source. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for water bodies that are not meeting designated uses under technology-based pollution controls. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and in stream water quality conditions so that states can establish water quality-based controls to reduce pollution and restore and maintain the quality of water resources (USEPA, 1991).

1.2 Watershed Description

The watershed of Cuffytown Creek in Greenwood, McCormick, and Edgefield Counties is in the Piedmont of western South Carolina (Figure 1). Cuffytown Creek joins with Hard Labor Creek to form Stevens Creek, a tributary of the Savannah River near Augusta, Georgia. This watershed is rural. Approximately 2100 people live in the Cuffytown Creek watershed (2000 US Census). This TMDL include that part of the watershed upstream of the water quality station. Information about the watershed is given in Table 1.

Table 1. Cuffytown Creek water quality monitoring site description.

Watershed	Station ID	Sampling Station Description	Drainage Area km^2	mi^2	Population (2000 Census)
Cuffytown Creek	SV-351	Cuffytown Creek at S-33-138	221.5	85.5	2096

The predominant land use in the Cuffytown Creek watershed, according to the 1992 NLCD, was forest, consisting of 86 % of the land (Table 2 and Figure 2). The lower part of the watershed is within the boundaries of the Sumter National Forest (Figure 3). Agricultural land uses made up 11 % of the watershed; of which somewhat more half was pasture/hay and the rest cropland. Land that was designated transitional, made up almost 3 %. Developed land was less than 1 % of the land in the watershed.

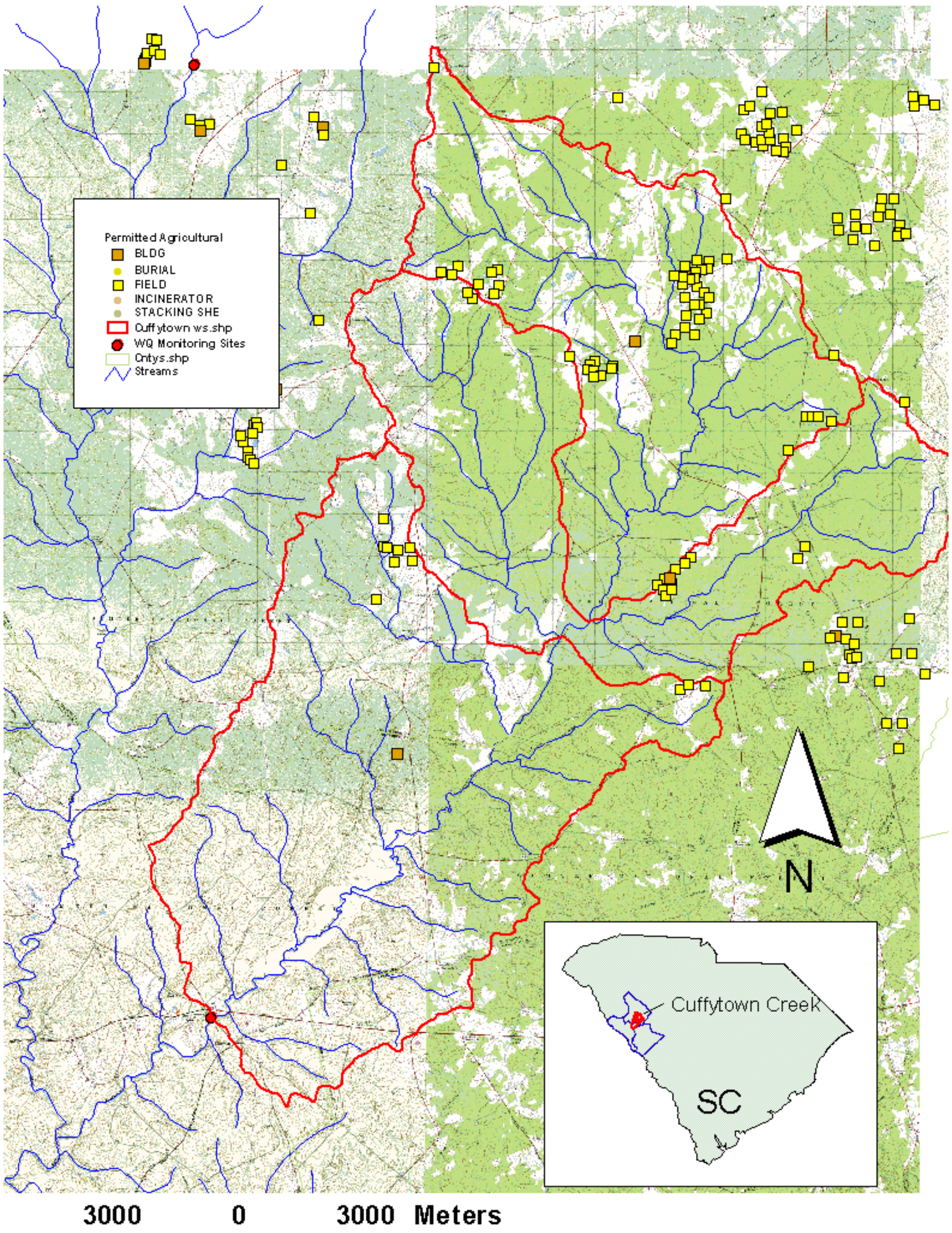

Figure 1. Map of the Cuffytown Creek watershed to SV-351, Savannah Basin.

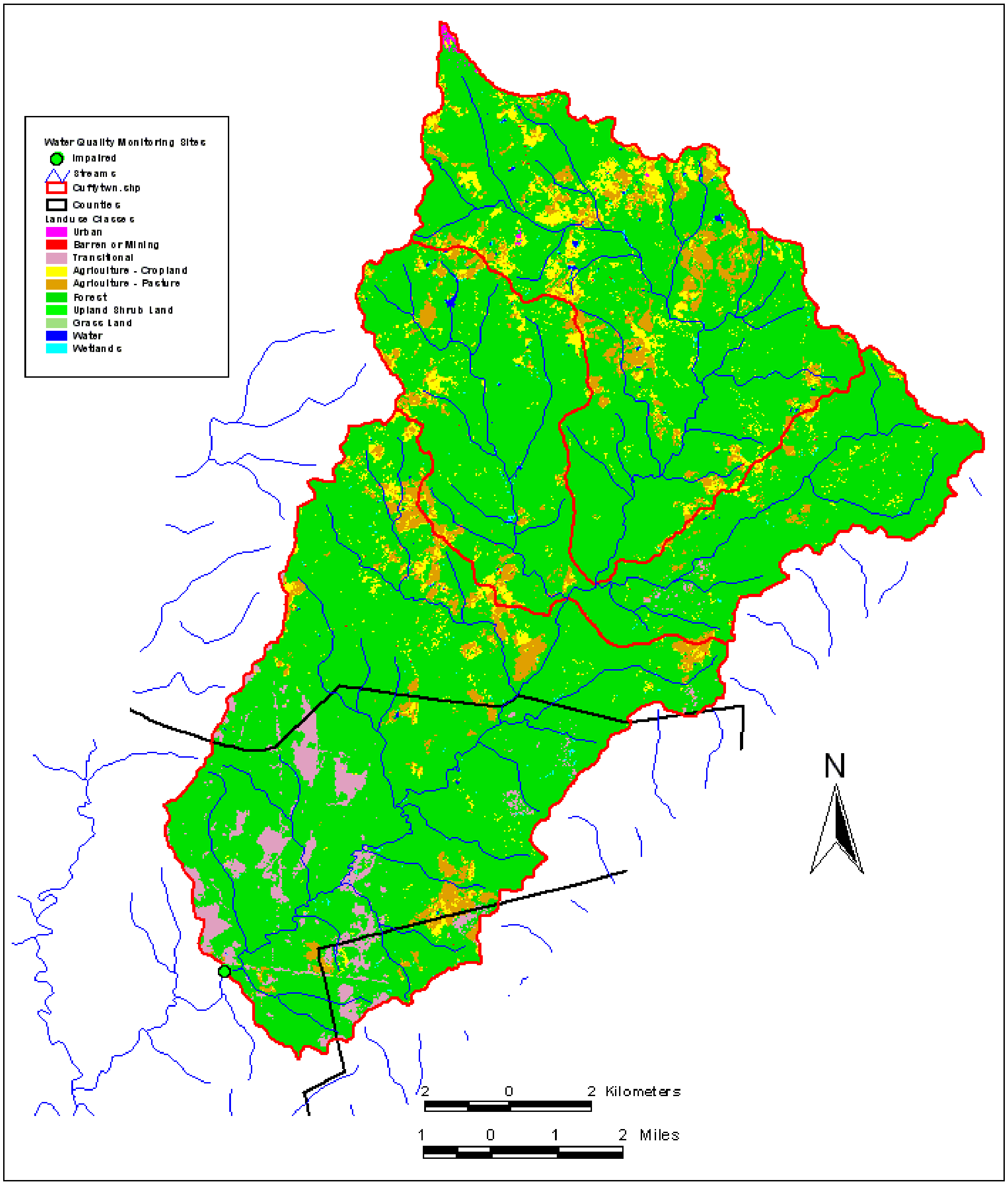

Figure 2. Map showing land uses in the Cuffytown Creek watershed.

Table 2. Land uses in Cuffytown Creek watershed upstream of S-33-138.

Land Use Groups	Land Use Class	Land Use Class Area (hectares)	Land Use Class Area (acres)	Land Use Group Area (hec-tares)	Percent
Water	Water	37	90	37	0.2%
Developed	Residential Low Density	11	27		
	Residential High Density	0	1		
	Commercial, Industrial, & Transportation	7	16		
				18	0.1%
	Barren Rock, Sand or Clay	11	28		
	Transitional	642	1,587		
Barren				653	2.9%
Forest	Forest Deciduous	**4,476**	**11,060**		
	Forest Evergreen	**10,921**	**26,985**		
	Forest Mixed	**3,602**	**8,901**		
				18,999	**85.8%**
Agricultural	Pasture/Hay	**1,345**	**3,323**		
	Cropland	**1,039**	**2,567**		
	Urban or Recreational Grasses	2	6		
				2,386	**10.8%**
	Wetlands Woody	58	143		
	Wetlands Herbaceous	1	2		
Wetlands				59	0.3%
Total for Watershed		**22,151**	**54,736**		**100.0%**

1.3 Water Quality Standard

The impaired stream segment of Cuffytown Creek is designated as Class Freshwater. Waters of this class are described as follows:

> "Freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department. Suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Suitable also for industrial and agricultural uses." (R.61-68)

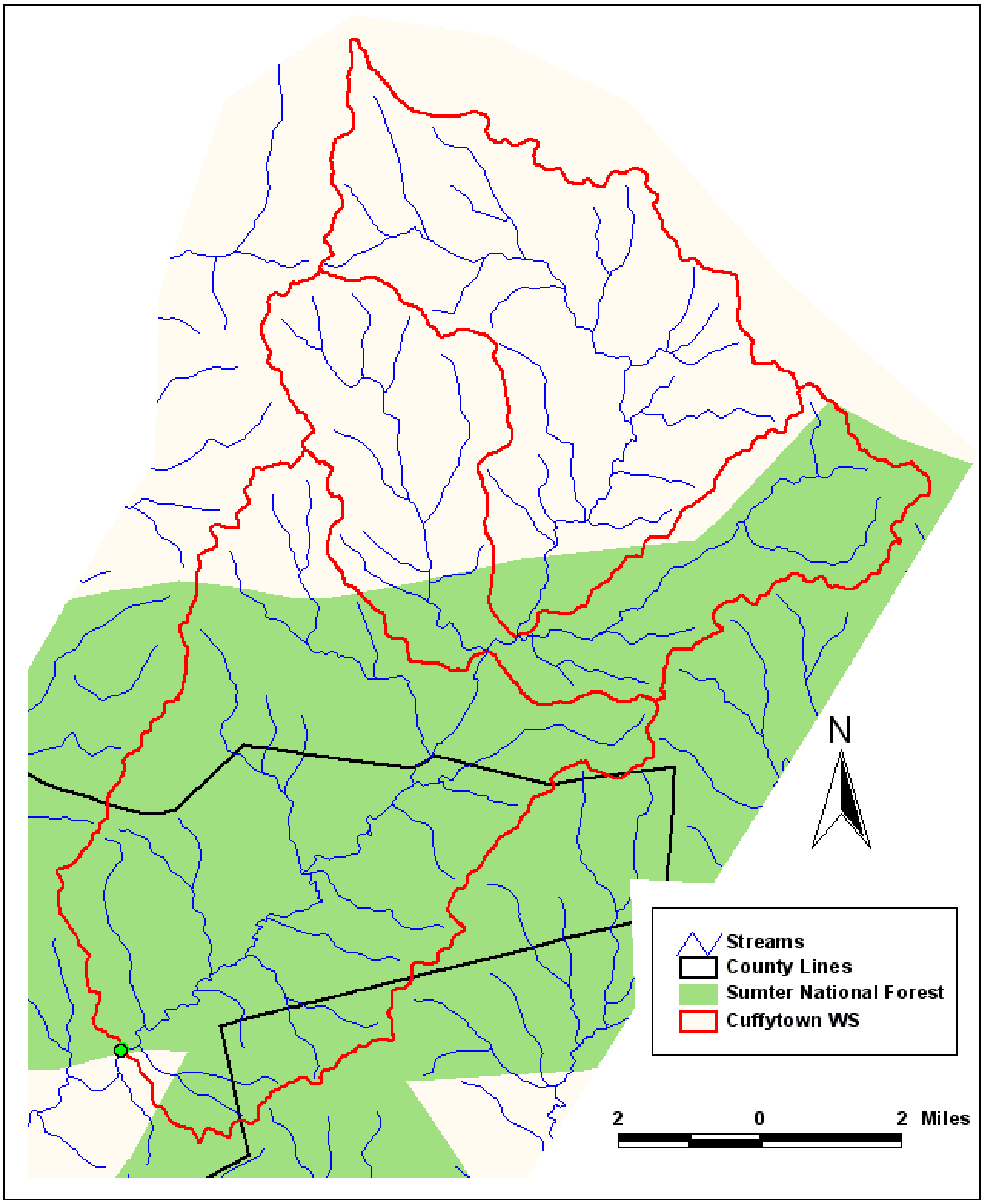

Figure 3. Sumter National Forest in the Cuffytown Creek watershed.

South Carolina's standard for fecal coliform in Freshwater is:

> "Not to exceed a geometric mean of 200/100 ml, based on five consecutive samples during any 30 day period; nor shall more than 10% of the total samples during any 30 day period exceed 400/100 ml."(R.61-68).

Primary contact recreation is not limited to large streams and lakes. Even streams that are too small to swim in, will allow small children the opportunity to play and immerse their hands and faces. Essentially all perennial streams should therefore be protected from pathogen impairment.

2.0 WATER QUALITY ASSESSMENT

Cuffytown Creek has one water quality monitoring station (Table 1 and Figure 1). An assessment of water quality data collected from 1998 through 2002 for the 2004 303(d) list at this station indicated that it was impaired for recreational use. Cuffytown Creek at SV-351 has been on the 303(d) list of impaired waters since 1998. Waters in which no more than 10% of the samples collected over a five year period are greater than 400 fecal coliform counts or cfu / 100 ml are considered to comply with the South Carolina water quality standard for fecal coliform bacteria. Waters with more than 10 percent of samples greater than 400 cfu/ 100 ml are considered impaired for fecal coliform bacteria and placed on South Carolina's 303(d) list. During the most recent assessment period (1998-2002), 21 % of samples did not meet the fecal coliform criterion at SV-351. Fecal coliform data collected since 1995 at SV-351 is provided in Appendix A Table A-1.

There has been little change in fecal coliform concentrations in Cuffytown Creek at location SV-351 since the 1998 assessment. The percentage of samples exceeding the standard of 400 cfu/100ml has remained about 20 % since the first assessment (Table 3). Likewise, fecal coliform concentrations when plotted over time show peaks of similar magnitude (Figure 4). However, water quality monitoring has been limited at this location, with sampling during only two periods since 1990 (Nov 1995-Oct 1996 and Nov 1999-Dec 2000), so that is prudent to be cautious in assessing this creek.

Table 3. Percentage of standard violations at SV-351 by 303(d) list.

Percent of Samples exceeding Std by Assessment Period:		
303(d)	**Period**	**Percent**
1998	1992-1996	17%
2000	1994-1998	17%
2002	1996-2000	17%
2004	1998-2002	21%

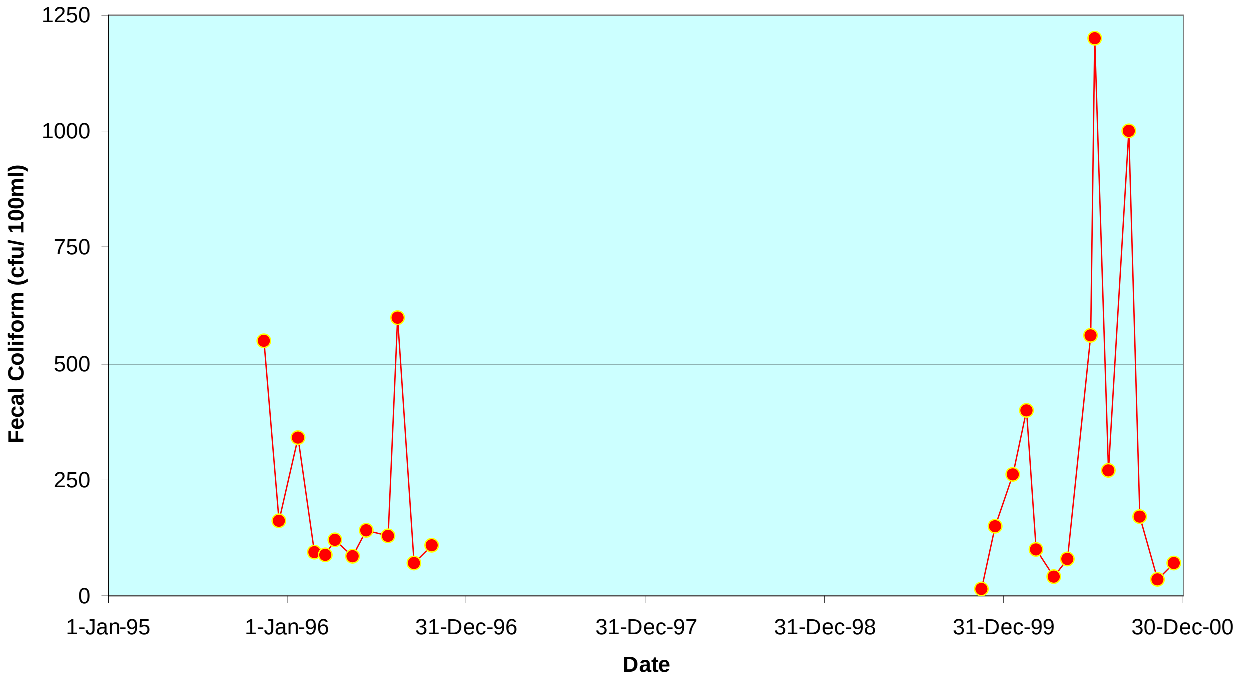

Figure 4. Fecal coliform concentrations in Cuffytown Creek at SV-351 over time.

Fecal coliform concentrations exhibited an apparent tendency to increase with turbidity in Cuffytown Creek (Figure 5). However, this correlation is not statistically significant; the r^2 for the linear regression of fecal coliform bacteria with turbidity was only 0.1071. Precipitation, as measured at Greenwood, shows a similar correlation (Figure 6). This pattern suggests that while runoff is the principal mode of fecal coliform entry into Cuffytown Creek, continuous sources in this rural watershed such as failing septic systems, illicit discharges, or livestock-in-the-creek are also present.

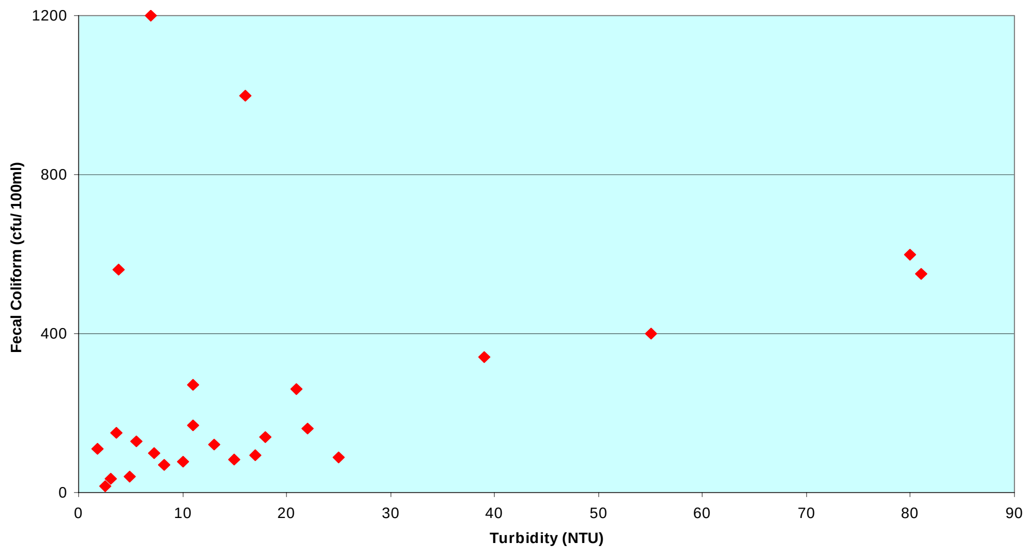

Figure 5. Relationship between turbidity and fecal coliform in Cuffytown Creek at SV-351.

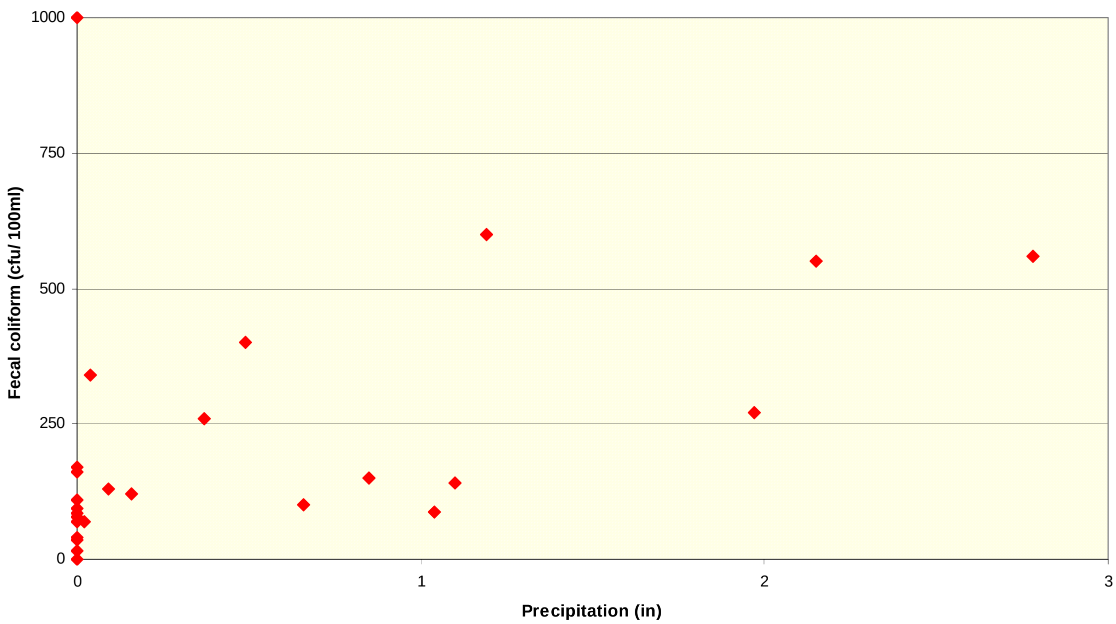

Figure 6. Relationship between fecal coliform and rainfall in Cuffytown Creek at SV-351.

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

Fecal coliform bacteria are used by the State of South Carolina as the indicator for pathogens in surface waters. Pathogens, which are usually difficult to detect, cause disease and make full body contact recreation in lakes and streams risky. Indicators such as fecal coliform bacteria, enteroccoci, or *E. coli* are easier to measure, have similar sources as pathogens, and persist a similar or longer length of time in surface waters. These bacteria are not in themselves usually disease causing.

There are many sources of pathogen pollution in surface waters. In general these sources may be classified as point and nonpoint sources. With the implementation of technology-based controls, pollution from point sources, such as factories and wastewater treatment facilities, has been greatly reduced. These point sources are required by the Clean Water Act to obtain a NPDES permit. In South Carolina NPDES permits require that dischargers of sanitary wastewater must meet the state standard for fecal coliform at the point of discharge. Municipal and private sanitary wastewater treatment facilities may occasionally be sources of pathogen or fecal coliform bacteria pollution. However, if these facilities are discharging wastewater that meets their permit limits, they are not causing the impairment. If one of these facilities is not meeting its permit limits, enforcement of the permit limit is required. A TMDL is not necessary for this purpose.

3.1 Point Sources

3.1.1 Continuous Point Sources

There are no NPDES dischargers in the Cuffytown Creek watershed.

3.1.2 Intermittent Point Sources

There are no designated Municipal Separate Storm Sewer Systems (MS4) in this watershed.

3.2 Nonpoint Sources

3.2.1 Wildlife

In these rural and suburban watersheds wildlife (mammals and birds), which is a source of fecal coliform bacteria, is possibly a significant though not major contributor. Wildlife in this area includes deer and other mammals as well as a variety of birds. Wildlife wastes are carried into nearby streams by runoff following rainfall or deposited directly in streams. Waterfowl also may be significant contributors of fecal coliform bacteria, particularly in urban and suburban ponds, which often provide a desirable habitat for geese and ducks. Forest lands, which typically have only low concentrations of wildlife as sources of fecal coliform bacteria, usually have low loading rates for fecal coliform bacteria.

3.2.2 Land Applied Manure

Livestock litter that is not properly stored or applied to land is a potential source of fecal coliform bacteria. Application of excessive amounts of litter, that is adding more nitrogen or phosphorus than the crop can use, and applying the litter too close to streams are the principal methods by which litter can pollute streams. The Cuffytown Creek watershed has one layer operation (Permit

#: ND0015365) that is permitted for 100,000 birds. In addition two other poultry farms (Permit #: ND0008496 and ND0061565), that are outside of the watershed, have 63 fields permitted for application of manure; these total at least 749 acres. Improperly applied or handled manure is a possible source of fecal coliform bacteria in Cuffytown Creek. These operations are permitted, therefore problems are managed through DHEC enforcement mechanisms.

3.2.3 Grazing Animals

Livestock, especially cattle, are frequently major contributors of fecal coliform bacteria to streams. Grazing cattle and other livestock may contaminate streams with fecal coliform bacteria in two ways. Runoff from pastures may carry the bacteria into streams following rain events. Cattle that are allowed access to streams deposit manure directly into the streams. Manure deposited in streams can be a significant source of fecal coliform bacteria. Loading of fecal coliform bacteria to both of these creeks by this route is likely to be a major source of loading of fecal coliform. The 2002 Agricultural Atlas reported 26,700 cattle and calves in Greenwood, McCormick, and Edgefield Counties. Using the ratio of pastureland in the each watershed to that of the appropriate county, 2080 cattle and calves were estimated to be in the SV-351 drainage area. Cattle in the creek are likely to be a major source of fecal coliform at SV-351.

3.2.4 Failing Septic Systems

Septic systems that do not function properly may leak sewage unto the land surface where it can reach nearby streams. Failing septic systems may be improperly designed or constructed or they maybe systems that no longer function. The number of households that have septic systems was estimated using a GIS. The 2000 census database layers were compared to the boundaries of the Cuffytown Creek watershed. In 2000 there were an estimated 2096 people in some 883 households in the Cuffytown Creek watershed. As there are no sewer services in this watershed, all of the population must use onsite waste treatment. The number of rural households should be close to the number of septic systems. Based on the evidence of continuous sources in the SV-351 part of the watershed, failing septic systems could be a major source of fecal coliform bacteria going into the stream.

3.2.5 Urban Nonpoint Sources

This watershed has no towns and developed land uses accounted for only 0.1 % of the land. Urban runoff is not significant in the Cuffytown Creek watershed.

Table 4. Total and rural populations in Cuffytown Creek watershed.

Station	Total Population	Rural Population	Rural Households
SV-351	2096	2096	883

4.0 LOAD-DURATION CURVE METHOD

Load-duration curves have been suggested as a method of developing TMDLs that applies to all hydrologic conditions (Cleland, 2003). This method requires less data and workhours than a modeling approach such as HSPF, but is more rigorous than the mass-balance method. The load-duration curve method uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the existing and the TMDL loads for a water body. Development of the load-duration curve is described in this chapter.

The load-duration curve method requires an adequate period of record for flow data. Generally a longer record is better, though after a record of 20 to 30 years, additional data would affect mostly the extreme values, which are usually not included in the load-duration curve. Cuffytown Creek, like many small streams in South Carolina is not gauged. The Little River, which is some 35 km northeast of Cuffytown Creek, is a comparable, gauged stream with similar land uses and topography. Data from the gauge (USGS 02167450) on the Little River near Silverstreet, South Carolina for the period of record (Mar.30, 1990 to July 31, 2004) was used to generate the flow-duration curve. The Little River watershed has a larger area, 556 km^2 compared to 222 km^2 for Cuffytown Creek watershed at SV-351. Land uses are similar: forest 72 % and agriculture 20 % in the Little River watershed compared to 86 % and 11 %, respectively, in Cuffytown Creek watershed (Compare Tables 2 and C-1 in Appendix C).

The flows for Cuffytown Creek at the water quality monitoring site were estimated by multiplying the daily flow rates from the Little River by the ratio of the Cuffytown Creek drainage area to that of Little River (0.3986). The flows were ranked in ascending order and the values that exceeded certain selected percentiles determined. A flow-duration curve for Cuffytown Creek at SV-351 is provided in Appendix C (Figure C-1). The load-duration curve was generated by calculating the load from the observed fecal coliform concentrations, the flow rate that corresponds to the date of sampling, and a conversion factor. The load was plotted against the appropriate flow recurrence interval to generate the curve (Figure 7). The target line was created by calculating the allowable load from the flow and the appropriate fecal coliform standard concentration in the same manner. Sample loads above this line are violations of the standard, while loads below the line are in compliance.

The water quality target was set at 380 cfu/100ml for the instantaneous criterion, which is five percent lower than the water quality criteria of 400 cfu/100ml. This five percent explicit Margin of Safety (MOS) was reserved from the water quality criteria in developing the load-duration curves. The instantaneous criterion was targeted as a conservative approach and should be protective of both the instantaneous and 30-day geometric mean fecal coliform bacteria standards.

A trend line was determined for sample loads that exceeded the standard (Figure 7). The trend line for SV-351 was a power function. The r^2 for this station (correlation coefficient) was 0.9334. The existing load to Cuffytown Creek at the monitoring station was calculated from the means of all loads that were between the 5 % and 95 % flow recurrence intervals for each location. This excludes flows that occur infrequently. These trend lines matched their respective target lines better than the alternatives and have acceptable correlation coefficients (r^2).

The TMDL load is calculated from the target line. Load values at 5 % occurrence intervals along the target line from 5 to 95 % were averaged. The Load Allocation (LA) values are derived from the 380 cfu/100ml water quality target, which includes the explicit Margin of Safety. Calculations for both existing and TMDL loads are provided in Appendix B.

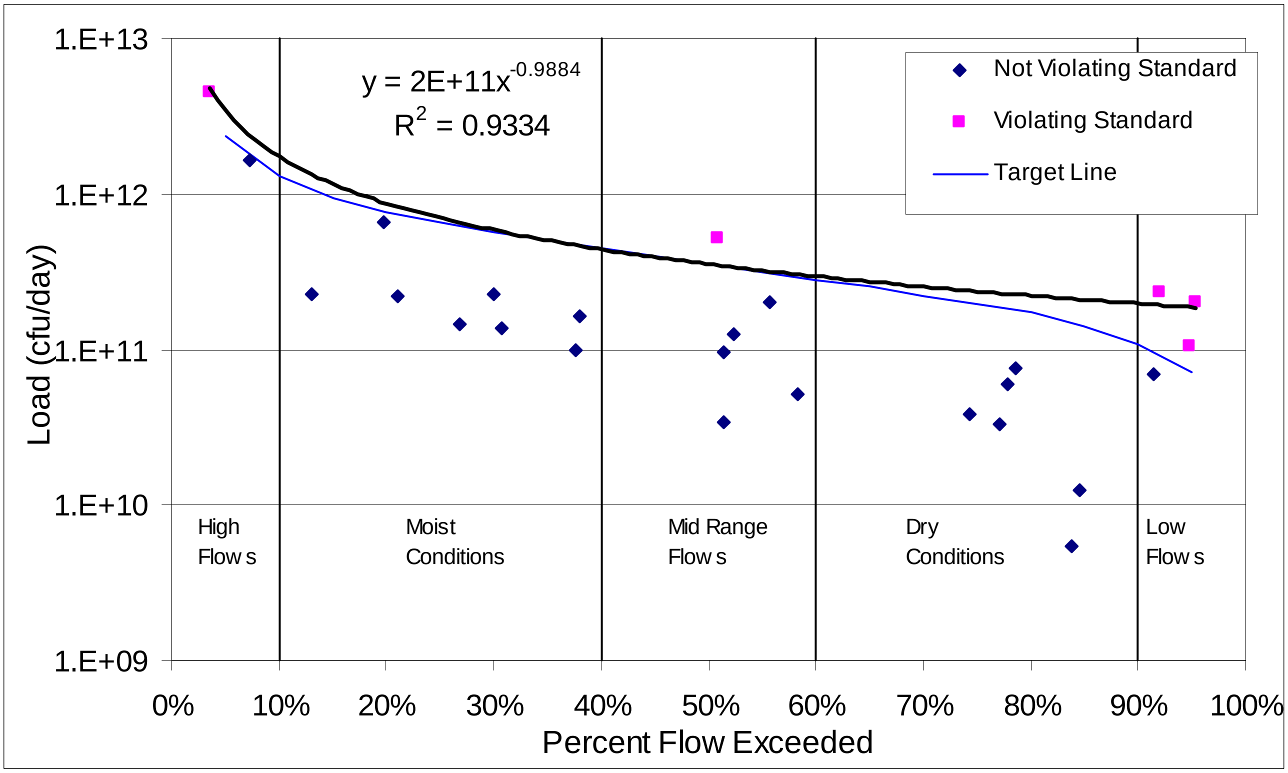

Figure 6. Load-duration curve for Cuffytown Creek at SV-351.

5.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

A total maximum daily load (TMDL) for a given pollutant and water body is comprised of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. Conceptually, this definition is represented by the equation:

$$\text{TMDL} = \Sigma\ \text{WLAs} + \Sigma\ \text{LAs} + \text{MOS}$$

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis to establish water quality-based controls.

For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). For bacteria, however, TMDLs are expressed in terms of number (#), cfu, or organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l).

5.1 Critical Conditions

These TMDLs are based on the flow recurrence interval between 5 % and 95 %. This encompasses 90 % of flows in Cuffytown Creek. Only flows that are in the top or bottom 5 % of all flows are not included in the analysis. For this TMDL critical conditions are this range of the flow recurrence interval.

5.2 Existing Load

The existing load was calculated from the trend lines of observed values that exceeded the water quality standard and were between and including 5 and 95 % recurrence limits. Loadings from all sources are included in this value: runoff, cattle-in-streams, and failing septic systems. The existing load for Cuffytown Creek is provided in Table 5.

5.3 Margin of Safety

The margin of safety (MOS) may be explicit and/or implicit. The explicit margin of safety is 5 % of the TMDL or 20 counts/ 100ml of the instantaneous criterion of 400 cfu/100 ml. The value of the MOS for this TMDL is provided in Table 5.

5.4 TMDL

For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). For bacteria, however, TMDLs are expressed in terms of cfu or organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l). The resulting TMDL should be protective of both the instantaneous, per day, and geometric mean, per 30-day, criteria.

The target loading value is the load to the creek that it can receive and meet the water quality standard. It is simply the TMDL minus the MOS. Values for each component of the TMDL for SV-351 on Cuffytown Creek are provided in Table 5. The required reduction in load, expressed as a percentage, is 11 %.

Table 5. TMDL components for Cuffytown Creek.

Impaired Station	Existing Load cfu/day	WLA cfu/day	MS4 WLA %	LA cfu/day	MOS cfu/day	TMDL cfu/day	% Reduction
SV-351	5.6E+11	NA	NA	4.98E+11	2.62E+10	5.24E+11	11

6.0 IMPLEMENTATION

As discussed in the *Implementation Plan for Achieving Total Maximum Daily Load Reductions From Nonpoint Sources for the State of South Carolina* (SCDHEC,1998), South Carolina has several tools available for implementing this nonpoint source TMDL. Specifically, SCDHEC's animal agriculture permitting program addresses animal operations and land application of animal wastes. In addition, SCDHEC will work with the existing agencies in the area to provide nonpoint source education in the Cuffytown Creek watershed. Local sources of nonpoint source education and assistance include Clemson Extension Service, the Natural Resource Conservation Service (NRCS), the Greenwood, McCormick, and Edgefield Counties Soil and Water Conservation Services, and the South Carolina Department of Natural Resources. Clemson Extension Service offers a 'Farm-A-Syst' package to farmers. Farm-A-Syst allows the farmer to evaluate practices on their property and determine the nonpoint source impact they may be having. It recommends best management practices (BMPs) to correct nonpoint source problems on the farm. NRCS can provide cost share money to land owners installing BMPs.

SCDHEC is empowered under the State Pollution Control Act to perform investigations of and pursue enforcement for activities and conditions, which threaten the quality of waters of the state. In addition, other interested parties (universities, local watershed groups, etc.) may apply for section 319 grants to install BMPs that will reduce fecal coliform loading to Cuffytown Creek. TMDL implementation projects are given highest priority for 319 funding.

In addition to the resources cited above for the implementation of this TMDL in the Cuffytown Creek watershed, Clemson Extension has developed a Home-A-Syst handbook that can help rural homeowners reduce sources of NPS pollution on their property. This document guides homeowners through a self-assessment, including information on proper maintenance practices for septic tanks. SCDHEC also employs a nonpoint source educator who can assist with distribution of these tools as well as provide additional BMP information.

Using existing authorities and mechanisms, these measures will be implemented in these two watersheds in order to bring about the required reductions in fecal coliform bacteria loading to Cuffytown Creek. DHEC will continue to monitor, according to the basin monitoring schedule, the effectiveness of implementation measures and evaluate stream water quality as the implementation strategy progresses.

7.0 REFERENCES AND BIBLIOGRAPHY

Cleland, B. R. 2003. *TMDL Development from the "Bottom Up" – Part III: Duration Curves and Wet-Weather Assessments*. National TMDL Science and Policy 2003 -- WEF Specialty Conference, Chicago, IL. November 2003.

Gaffield, S. J., R. L. Goo, L.A. Richards, and R. J. Jackson. 2003. Public Health Effects of Inadequately Managed Stormwater. in Runoff. *American Journal of Public Health* 93(9): 1527-1533. September 2003.

Novotny, V. and H. Olem. 1994. Water Quality Prevention, Identification, and Management of Diffuse Pollution. Van Nostrand Reinhold, New York.

SCDHEC. 2003. Watershed Water Quality Assessment: Savannah River Basin. Technical Report No. 002-03.

SCDHEC. 1998. Implementation Plan for Achieving Total Maximum Daily Load Reductions From Nonpoint Sources for the State of South Carolina.

Schueler, T. R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Publ. No. 87703. Metropolitan Washington Council of Governments, Washington, DC.

Schueler, T. R. 1999. Microbes and Urban Watersheds: Concentrations, Sources, and Pathways. *Watershed Protection Techniques* 3(1): 554-565.

United States Environmental Protection Agency (USEPA). 1983. Final Report of the Nationwide Urban Runoff Program, Vol 1. Water Planning Division, US Environmental Protection Agency, Washington, DC.

United States Environmental Protection Agency (USEPA). 1991. Guidance for Water Quality-Based Decisions: The TMDL Process. Office of Water, EPA 440/4-91-001.

United States Environmental Protection Agency (USEPA). 2001. Protocol for Developing Pathogen TMDLs. First Edition. Office of Water, EPA 841-R-00-002.

US Geological Survey. 1999. 1999 Water-Resources Data South Carolina Water Year 1999. United States Geological Survey

APPENDIX A Fecal Coliform Data

Table A-1 Fecal coliform data for Cuffytown Creek at S-33-138 (SV-351).

Date	Turbidity (NTU)	Fecal Coliform (cfu/ 100ml)
14-Nov-95	81.0	550
14-Dec-95	22.0	160
22-Jan-96	39.0	340
26-Feb-96	17.0	95
18-Mar-96	25.0	88
8-Apr-96	13.0	120
13-May-96	15.0	84
10-Jun-96	18.0	140
23-Jul-96	5.6	130
12-Aug-96	80.0	600
16-Sep-96	8.2	70
22-Oct-96	1.8	110
15-Nov-99	2.6	15
15-Dec-99	3.6	150
20-Jan-00	21	260
16-Feb-00	55	400
6-Mar-00	7.3	100
13-Apr-00	4.9	40
10-May-00	10	78
27-Jun-00	3.9	560
5-Jul-00	7	1200
1-Aug-00	11	270
11-Sep-00	16	1000
4-Oct-00	11	170
8-Nov-00	3.1	35
13-Dec-00	8.2	70

Table A-2 Statistics for fecal coliform data 1995-2000 in Cuffytown Creek (cfu/100ml).

Statistics:		
Minimum		15
Geometric Mean		157
Median		135
Maximum		1200
Percent Violations		19.2%

APPENDIX B Calculation of Existing and TMDL Loads

Table B-1 Calculation of existing load.

Calculation of Existing Load
Equation: y = 2E+11 x ^ -0.9884

% Exceeded	Load (cfu/day)
0.05	3.86E+12
0.10	1.95E+12
0.15	1.30E+12
0.20	9.82E+11
0.25	7.87E+11
0.30	6.57E+11
0.35	5.65E+11
0.40	4.95E+11
0.45	4.40E+11
0.50	3.97E+11
0.55	3.61E+11
0.60	3.31E+11
0.65	3.06E+11
0.70	2.85E+11
0.75	2.66E+11
0.80	2.49E+11
0.85	2.35E+11
0.90	2.22E+11
0.95	2.10E+11
Mean Load	**5.58E+11**

Table B-2. Calculations of TMDL load.

Calculation of TMDL Load
Target Conc 380 cfu/100ml
From Target Line

% Exceeded	Load (cfu/day)		Flow (cfs)
0.05	2.20E+12		236.73
0.10	1.22E+12		130.74
0.15	8.82E+11		94.87
0.20	7.26E+11		78.12
0.25	6.16E+11		66.27
0.30	5.34E+11		57.40
0.35	4.74E+11		51.02
0.40	4.19E+11		45.04
0.45	3.78E+11		40.66
0.50	3.37E+11		36.27
0.55	3.00E+11		32.29
0.60	2.67E+11		28.70
0.65	2.41E+11		25.91
0.70	2.11E+11		22.72
0.75	1.85E+11		19.93
0.80	1.63E+11		17.54
0.85	1.33E+11		14.35
0.90	1.04E+11		11.16
0.95	6.67E+10		7.17
Mean Load	**4.98E+11**		

Table B-3 Calculation of percent reductions.

Percent Reduction Required:		
Existing Load:	5.58E+11	cfu/day
TMDL Load:	4.98E+11	cfu/day
Load Reduction:	6.02E+10	cfu/day
Percent reduction:	**10.8%**	

APPENDIX C Miscellaneous Tables and Figures

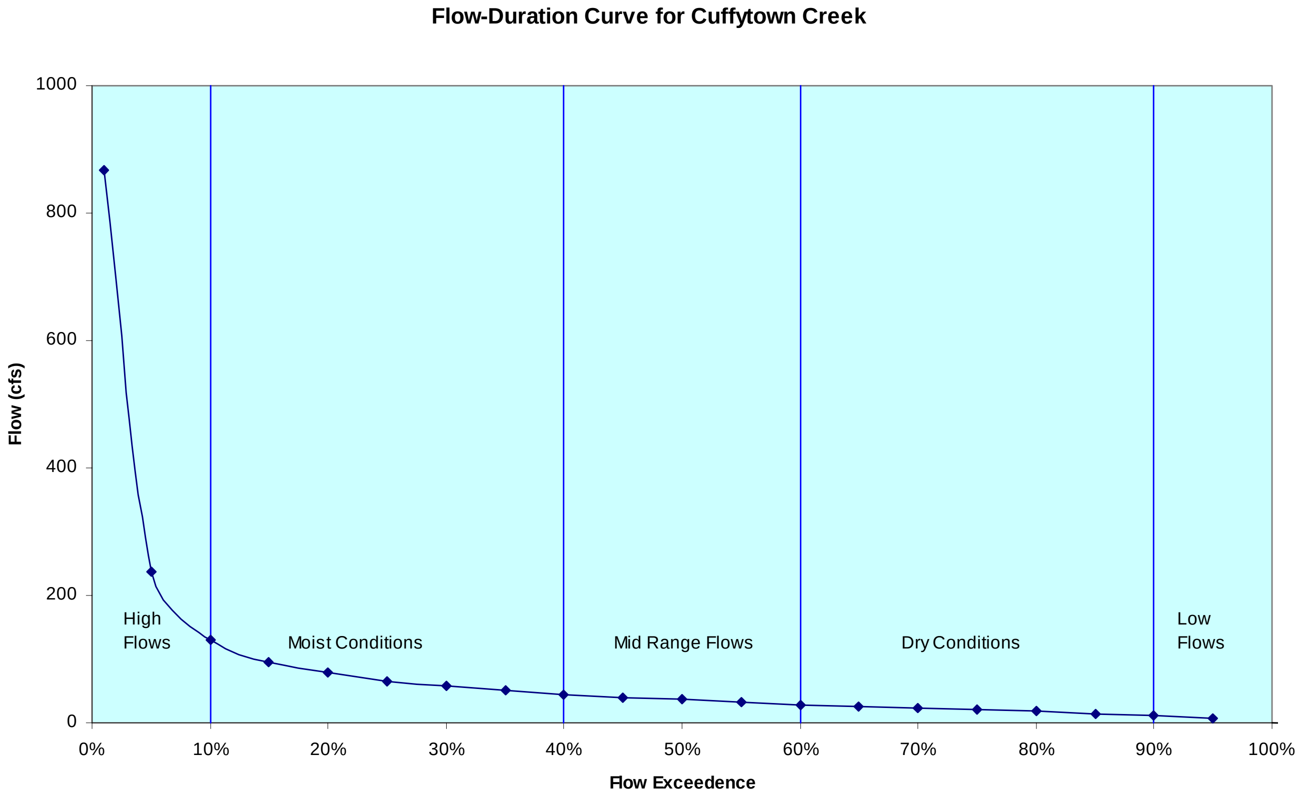

Figure C-1 Flow-duration curve for Cuffytown Creek at SV-351.

Table C-1. Land uses in the Little River drainage to USGS gauging Station 02167450.

Land Use Classes	Land Uses	Area (hectares)		Percent
		Land Uses	Land Use Classes	
Water	Water	134	134	0.2%
	Residential Low Density	1,279		
	Residential High Density	164		
	Commercial, Industrial,	460		
Developed			1,904	3.3%
	Barren Rock, Sand or Clay	57		
	Mining	85		
	Transitional	2,427		
Barren			2,569	4.4%
	Forest Deciduous	15,893		
	Forest Evergreen	17,837		
	Forest Mixed	7,830		
Forest			41,561	71.7%
	Pasture/Hay	6,263		
	Cropland	5,180		
	Urban or Recreational Grass	213		
Agriculture			11,656	20.1%
	Wetlands Woody	164		
	Wetlands Herbacecous	6		
Wetlands			170	0.3%
Totals			57,994	100.0%

APPENDIX D Public Notification